How cosmology got into such a despicable mess

By Pierre Berrigan
October 2020
For A Cosmology Group

What history says

It all began in 1890. That's when American astronomer James Edward Keeler[i] at the Lick observatory in California, received a request from his British counterpart Sir William Huggins to investigate the spectral lines displacement of the Orion Nebula. Apparently, Huggins had unsuccessfully exhausted all of United Kingdom's astronomical resources in the quest.

Keeler probably got carried away because not only did he produce as many as 26 photographic plates showing Orion's spectra displacement as per Huggins request[ii] but he extended the exercise to 10 others of what was then known under the name of « planetary nebulae », as they had been classified a century earlier by Sir William Herschel. Keeler published his results in the November 1890 issue of the Journal of the Astronomical Society of the Pacific, with measurements expressed both in spectral lines offset in units of tenth-meters, and in units of miles per second of velocity in the line of sight, a calculation made under the assumption that the spectral displacements were the result of the Doppler effect of the object's radial motion relative to Earth. The velocities reported by Keeler of these 10 objects ranged from -31 to +38 miles per second, half of them being motions towards and the other half away.

As far as history records, Huggins, in 1864, was the first to aim a spectrograph at some extragalactic object, and Keeler, in 1890, the first to measure and report the radial velocity of galaxies.

The work of Keeler attracted the interest of a young freshly graduated astronomer of Lowell observatory, 35-year-old Vesto Slipher. In 1917, Slipher[iii] published a list of 25 nebulae of which he had compiled the spectra over the preceding 5 years. Some, as for example M31, M32, M33 and M81 had their spectral lines shifted towards the blue, while most others displayed a red shift. Again, the motions observed were randomly distributed within a range that, despite being somewhat higher, had nothing particularly unusual, between -300 and +1100 kilometers per second. There was, however, more positive velocities than negative ones in Slipher's samples: 21 out of 25, a trend that did not go unnoticed, but that was still insufficient to question the methodology or the assumption. Also worth mentioning is that the spectral shifts in units of tenths of meters of wavelength was completely left out in Slipher's article, to be only reported in units of kilometers per second of radial velocity.

The context.

One has to appreciate the context here. The astronomers of the beginning of the century had not a single clue that "nebulae" were anything else than some strange starry manifestation happening a relatively short distance away. To quote Huggins in 1864:

> *« It became therefore an object of great importance, in reference to our knowledge of the visible universe, to ascertain whether this similarity of plan observable among the stars,*

and uniting them with our sun into one great group, extended to the distinct and remarkable class of bodies known as nebulae. »[iv]

And Keeler in 1890:

« The stars, which in general are found to have considerable motions in space, are, according to modern views, evolved from pre-existing nebulae by a process of contraction or condensation »

And Slipher, 25 years later:

« (nebulae) for a long time been generally regarded as presenting an early stage in the evolution of the stars and of our solar system »

And finally, Knut Lundmark in 1924:

"it seems allowable to assume that the displacements found for globular clusters and spiral nebulæ are due to motions of the objects"

So, Huggins, Keeler, Slipher, Lundmark and others of their contemporaries, routinely used spectroscopy to study not only the chemical composition of stars, but also their motion relative to Earth, by measuring the amount of Doppler shift of their spectral emissions or absorptions.

Finally, there is the fact that the measurements of line-of-sight motions made sense. Or, to put it another way, bore no absurd characteristics that could justify putting the methodology or the assumption (Doppler effect) in doubt. The motions seemed to be randomly and equally distributed between approaching and receding, and were in a range of what was customarily observed in stars.

It was therefore natural for astronomers to assume that the displacement of the spectral lines in nebulae was indicative of their radial displacement based on a Doppler effect, some moving towards us, some away from us, in what appeared to be proper motions.

It was nevertheless logically incorrect. Of course, the Doppler effect causes a spectral shift, but that doesn't imply that all spectral shifts are necessarily caused by a Doppler effect. In formal logic, thinking otherwise is a fallacy of the type « affirming the consequent », as in « Radial motion causes spectral shifts. Galaxies show spectral shifts. Therefore, galaxies have radial motion ». This may seem obvious, but you would be surprised how many great minds make this kind of logic mistake, even today.

It gets complicated.

In the decade that followed, the measurement of the nebulae's distance became the main challenge of astronomy. From assumptions including uniform intrinsic luminosity, novae, cepheids, or absolute sizes, astronomers correlated Slipher's spectral shifts with what they estimated were the nebulae's distance. Although most of the original estimates may have been off by a factor of 10 and sometimes more, there was no doubt any more that the « nebulae » were too far away to be considered anything that belonged to our « stellar system », as our Milky Way galaxy was then called. Despite that, and in the wake of Slipher's work, each newly observed nebula was tagged with its spectral shift, again represented in units of kilometers per second.

Only thing: as more and more “nebulae” spectra were measured, their spectral shifts seemed to display a trend towards the red...

That’s when things started becoming a bit more complicated. The correlations between distances and spectral displacements were leading to strange conclusions: the further away the nebula the greater the red shift. It was as if the galaxies were moving away from us, at velocities proportional to their distance: the further out, the faster. Slipher's blue shifted spectra became curious outliers, and ended up being ignored.

But astronomers were circumspect. Both Lundmark[v] and Hubble[vi] expressed the possibility that the redshifts could be “certain effects consequent to the general theory of relativity”, or the DeSitter effect of the curvature of spacetime, which showed the weakness of their belief in an expanding universe scenario. Up to until 1947, Hubble still talked of a « hitherto unknown principle of nature »[vii] and that it « seems likely that red-shifts may not be due to an expanding universe, and much of the current speculation on the structure of the universe may require re-examination ».

The crossroad

At the end of the 1920’s, astrophysics was at a crossroad.

For one thing, it was now obvious that the « nebulae » were a totally different kind of objects, that had nothing whatsoever in common with anything astronomy had ever dealt with before: they were not planets, asteroids, comets, stars, not even the hypothetical unborn stars, or gaseous clouds of incandescent material. They were full-fledge galaxies; Immanuel Kant's century old hypothetical « island universe » was finally fact.

Secondly, the « nebulae » were so amazingly far away that their mind-boggling distances required a major rethinking of how the universe was conceived. Distances measured in millions of light-years were orders of magnitude larger than anything anyone could conceive, even among the most seasoned astronomers.

And thirdly, contrary to observations made so far, the MEASUREMENTS MADE NO SENSE! That galaxies would exhibit a common behaviour was contrary to everything characteristically random observed so far in their nature, whether it was in terms of their celestial distribution, angle, tilt, size, shape, etc. The idea that objects as fantastically gigantic as galaxies would systematically move away from us had preposterous consequences. For one thing, it meant that the earth was at the center of the universe, an idea that science had been fighting against for millennia. It also meant that at distances large enough, galaxies would move faster then the speed of light. And it meant that at some moment in the past, everything that the universe contained was clumped in a single humongous mass that would have started expanding for reasons unexplainable by any argument other than mythical.

Huggins got his answer: no, the « similarity of plan uniting the stars with our sun into one great group » does not extend to nebulae.

All the necessary ingredients for a re-examination of the assumptions were present. Does the Doppler effect really explain the spectral shifts of galaxies? Is the Doppler effect applicable to objects so different in nature, and so farther away from anything else science has ever observed? Do galaxies really have a common and uniform radial motion? Some alarms should have been ringing...

The big mistake

But instead, it was Catholic canon George Lemaitre[viii] who, probably inspired by the De Sitter hypothesis, published a solution to general relativity that mathematically described an expanding universe (what else would you expect from the stress-energy tensor of a hyper sphere surrounded by nothingness?) and its birth from a « cosmic egg » the cause of which was left to some extra-scientific discipline, an obvious hint at the makings of a Creator.

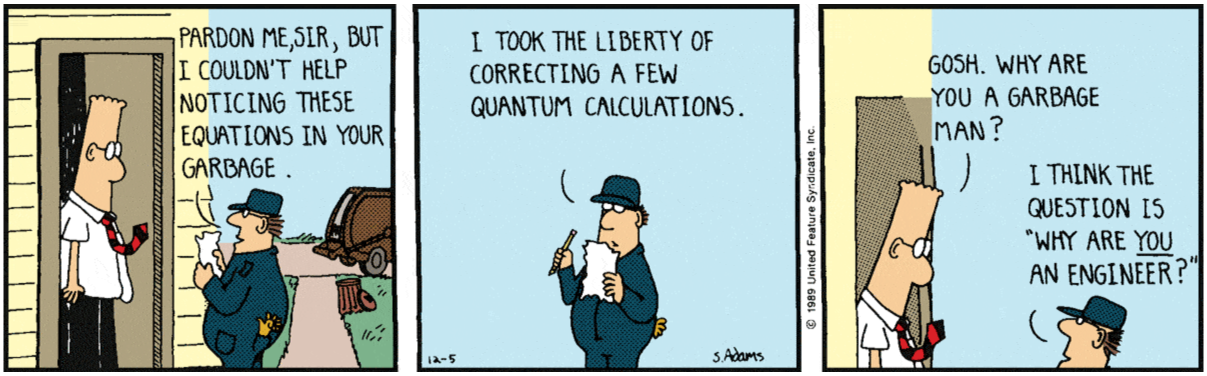
The year is 1927. That's when cosmology's big mistake happened.

Despite every warning sign and evidence that the knowledge of the universe had undergone a sudden and dramatic change, and that a revision of the assumption was in order, the priest's theory was to be adopted and raised to the status of dogma, a sign of the enormous domination the Roman Catholic Church had on the western civilization.

Hubble was tossed aside in the most cunning way: by giving him credit for the discovery that the universe was expanding! His name was even given to the rate at which it happened: the Hubble constant. Others had tried as well: Zwicky, Hoyle, Arp, Burbidge... but theirs turned out to be half cooked theories too hastily laid out and were swiftly ignored.

And then, things really got out of hand.

With the help of Alexander Friedman's mathematical model of a topology that had more distance the further you went, the radial motion of galaxies was permitted to exceed the speed of light... Strange and mysterious objects and substances started filing up the theoretical universe: dark matter, dark energy, black holes, multiverses, wormholes, quantum foam... The expansion of the universe, nowadays, is routinely stated as the cause of the redshift, overlooking the historical fact that it was the redshift that led to the expanding universe hypothesis in the first place, in a perfectly tight circular reasoning. And the cherry on the top: the discovery of the Cosmic Microwave Background Radiation, that fitted right in the model as the grandiose afterglow of the mighty bang that gave birth to the universe (provided you ignore the dipoles, of course) and that allowed to estimate the « age of the universe ».



That's how we ended up, a hundred years later, with a mathematical map that scientists insist is the territory.

The fix.

The analytical method, when applied to a broken system, proceeds by decomposing the system into elementary components, identifying and fixing the faulty component, and rebuilding the system by the inverse process: synthesis.

There is no denying that the « system » of modern cosmology is broken, as inconsistencies as the Hubble and the σ_8 tensions suggest, not to mention the unexplained abundance of lithium, fully formed galaxies at high z, matter-antimatter asymmetry, and so on. Scientific theories usually explain things; the Big Bang theory does exactly the opposite, as its most solid prediction is that 95 percent of the contents of the universe is… unknown!

It seems obvious that 1927 was a turning point in cosmology, and it appears that the wrong turn was taken. The failure of astrophysics to reconsider its working hypothesis about redshift of galaxies when it was called for certainly qualifies as a faulty « component » by analogy with the analytical method. That elementary component needs to be fixed, and the « system » (i.e.: cosmology) rebuilt from that point forward.

The fix is simple: assume that the spectral shift of extragalactic objects is not a Doppler effect, or any other theoretical underlying mechanism that requires galaxies to be rushing away from one another.

The fix is simple, but it is also radical. A century of scientific development has plentily demonstrated that the Doppler redshift hypothesis leads to a dead end. For any theoretical model of the cosmos that relies on this hypothesis or some variant, the same dead end is unavoidable, save it being faulty with regards to observations or logic. And whenever an assumption yields theoretically inconsistent or physically absurd results, the assumption itself must be considered wrong. Any such assumption will inevitably lead to the universe having appeared out of nowhere from a Big Bang, or eventually disappearing into a void in a Big Crunch, or both, or to cyclically huffing and puffing eternally from one such event to the other. <u>A true alternative to the Big Bang theory must therefore assume that the redshift of extragalactic objects is not the result of some form of radial displacement</u>.

Caution warranted.

Anyone, however, who is ready to go down that path should be prepared to confront some additional sophistic arguments from members of the mainstream establishment.

The most immediate is to the effect that there is no better explanation for the cosmological redshift, therefore, the Doppler effect must be correct. Or: that there exists no better model that explains the red shifts, cosmic background radiation, abundance of light elements, etc, therefore, the expanding space postulate of ΛCDM must be correct.

This is another kind of fallacy called in informal logic « argument from ignorance ». The only thing that it proves is, indeed, our ignorance! Worth mentioning is that an alternative explanation[ix] of the redshift is not a prerequisite to tackle some of the other mysteries of the cosmos. For example: what is the cause of the CMB dipole? What is the explanation for the curious rotation of galaxies? What happens when a mass accretes to a point where its escape velocity approaches the speed of light?

You will also get arguments in the form: ΛCDM, the expansion of the universe, the Big Bang, etc, have been widely accepted by renowned scientists from all over the world for half a century and therefore must be true. Fallacy: « appeal to authority »; « appeal to tradition ». Or: that the universe expanded from an initial very hot and dense state is a scientifically established and incontrovertible fact supported by mountains of evidence, etc, etc. Fallacy: « proof by assertion ». Or: anyone who objects to the Big Bang theory is an uneducated scientifically illiterate fundamentalist fool who can't think, a fraud, a crank, etc. Fallacy: « ad hominem ». Or still: the expansion of the universe is a prediction of general relativity which has been proven right in all circumstances (« proof by assertion ») therefore, the expansion of the universe is true. Fallacy: « map and territory ». And so on. Logic appears not to be their strong suit.

There is no point in being in a hurry; it's been a century of theoretical wandering; the alternate path deserves some time.

---

[i] Keeler, J. E., "On the Motions of the Planetary Nebulæ in the line of Sight.", *Publications of the Astronomical Society of the Pacific*, vol. 2, no. 11. p. 265, 1890. doi: 10.1086/120168. (http://articles.adsabs.harvard.edu/pdf/1890PASP....2..265K)
[ii] No author, "Notes and Correspondence", *Journal of the British Astronomical Association*, vol. 1. pp. 281–294, 1891. (http://articles.adsabs.harvard.edu/pdf/1891JBAA....1..281.)

[iii] Slipher, V. M., “Nebulae”, Proceedings of the American Philosophical Society, vol. 56. pp. 403–409, 1917. (http://articles.adsabs.harvard.edu/pdf/1917PAPhS..56..403S)
[iv] Huggins, William, "On the spectra of Some Nebulae", Philosophical transactions of the Royal Society ... v.154, 1864 (https://hdl.handle.net/2027/pst.000049721522?urlappend=%3Bseq=503)
[v] Lundmark, K., “The determination of the curvature of space-time in de Sitter's world”, *Monthly Notices of the Royal Astronomical Society*, vol. 84. pp. 747–770, 1924. doi: 10.1093/mnras/84.9.747. (http://articles.adsabs.harvard.edu/pdf/1924MNRAS..84..747L)
[vi] Hubble, E., “A Relation between Distance and Radial Velocity among Extra-Galactic Nebulae”, *Proceedings of the National Academy of Science*, vol. 15, no. 3. pp. 168–173, 1929. doi: 10.1073/pnas.15.3.168. (https://www.pnas.org/content/pnas/15/3/168.full.pdf)
[vii] Hubble, E., “The 200-Inch Telescope and Some Problems It May Solve”, *Publications of the Astronomical Society of the Pacific*, vol. 59, no. 349. p. 153, 1947. doi: 10.1086/125931 (http://articles.adsabs.harvard.edu/pdf/1947PASP...59..153H)
[viii] Lemaître, G., “Un Univers homogène de masse constante et de rayon croissant rendant compte de la vitesse radiale des nébuleuses extra-galactiques”, *Annales de la Société Scientifique de Bruxelles*, vol. 47. pp. 49–59, 1927. (http://articles.adsabs.harvard.edu/pdf/1927ASSB...47...49L)
[ix] Marmet, L., “On the Interpretation of Spectral Red-Shift in Astrophysics: A Survey of Red-Shift Mechanisms – II”, arXiv:1801.07582v1 [astro-ph.CO] (https://arxiv.org/pdf/1801.07582)